Name: __________ Date: __________

Polynomial Operations SOLUTION (version 117)

1. Let polynomials $p(x)$ and $q(x)$ be defined below.

$$p(x) = 6x^5 + 7x^4 + 4x^3 - 2x + 1$$

$$q(x) = -x^5 + 5x^4 - 3x^2 - 6x + 2$$

Express the sum of $p(x) + q(x)$ in standard form.

Get "unsimplified" forms. Then find $p(x) + q(x)$ with addition/subtraction.

$$\begin{aligned} p(x) &= (6)x^5 + (7)x^4 + (4)x^3 + (0)x^2 + (-2)x^1 + (1)x^0 \\ q(x) &= (-1)x^5 + (5)x^4 + (0)x^3 + (-3)x^2 + (-6)x^1 + (2)x^0 \\ p(x) + q(x) &= (5)x^5 + (12)x^4 + (4)x^3 + (-3)x^2 + (-8)x^1 + (3)x^0 \\ p(x) + q(x) &= 5x^5 + 12x^4 + 4x^3 - 3x^2 - 8x + 3 \end{aligned}$$

2. Let polynomials $a(x)$ and $b(x)$ be defined below.

$$a(x) = 3x^2 - 4x - 6$$

$$b(x) = 7x + 3$$

Express the product $a(x) \cdot b(x)$ in standard form.

You can use a table for multiplication.

*	$3x^2$	$-4x$	-6
$7x$	$21x^3$	$-28x^2$	$-42x$
3	$9x^2$	$-12x$	-18

$$a(x) \cdot b(x) = 21x^3 - 28x^2 + 9x^2 - 42x - 12x - 18$$

Combine like terms.

$$a(x) \cdot b(x) = 21x^3 - 19x^2 - 54x - 18$$

3. Express $(x + 1)^6$ in standard (expanded) form.

Remember the binomial theorem. It tells us to use Pascal's triangle.

$$x^6 + 6x^5 + 15x^4 + 20x^3 + 15x^2 + 6x + 1$$

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4. Let polynomials $f(x)$ and $g(x)$ be defined below.

$$\begin{aligned} f(x) &= 3x^3 - 28x^2 + 7x + 14 \\ g(x) &= x - 9 \end{aligned}$$

The quotient of $\frac{f(x)}{g(x)}$ can be expressed as a polynomial, $h(x)$, and a remainder, R (a real number).

$$\frac{f(x)}{g(x)} = h(x) + \frac{R}{x-9}$$

By using synthetic division or long division, express $h(x)$ in standard form, and find the remainder R.

I prefer using synthetic division.

$$\begin{array}{c|cccc} & 3 & -28 & 7 & 14 \\ 9 & & 27 & -9 & -18 \\ \hline & 3 & -1 & -2 & -4 \end{array}$$

So,

$$\frac{f(x)}{g(x)} = 3x^2 - x - 2 + \frac{-4}{x-9}$$

In other words, $h(x) = 3x^2 - x - 2$ and the remainder is $R = -4$.

5. Let polynomial $f(x)$ still be defined as $f(x) = 3x^3 - 28x^2 + 7x + 14$. Evaluate $f(9)$.

You could do this the hard way.

$$\begin{aligned} f(9) &= (3)\cdot(9)^3 \ + \ (-28)\cdot(9)^2 \ + \ (7)\cdot(9) \ + \ (14) \\ &= (3)\cdot(729) \ + \ (-28)\cdot(81) \ + \ (7)\cdot(9) \ + \ (14) \\ &= (2187) \ + \ (-2268) \ + \ (63) \ + \ (14) \\ &= -4 \end{aligned}$$

Or, if you reference the polynomial remainder theorem, you can state that you know $f(9)$ equals the remainder when $f(x)$ is divided by $x - 9$. Thus, $f(9) = -4$.